THERMAL EFFECT IN PRESSURE FLUCTUATION: INTERNAL FLOW

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"قل إن صلاتي ونسكي ومحياي ومماتي لله رب العلمين"

6:162 قرآن

6:162 Say: My contact prayer, and my rites, and my life, and my death, are all to Allah, Lord of the worlds.

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ABSTRACT

In industrial processes, turbulent flows are known to sometimes generate significant levels of noise and consequent vibrations of the structures. As well the involvement of the heat in the most engineering processes; this study focus on the effect of temperature of the internal flow in the tube has been investigated numerically to study the vibration tendency on the tube structure. The Fluent software has been used with LES solution provided for more accurate results. The results show the direct relation of the temperature in the vibration tendency. The results also show that the diameter of the tube has inverse relationship to the vibration tendency of the structure.

ABSTRAK

Dalam kajian ini, kesan suhu aliran dalaman dalam tiub telah disiasat berangka untuk mengkaji kecenderungan getaran pada struktur tiub. Perisian Fasih telah digunakan dengan penyelesaian LES disediakan untuk hasil yang lebih tepat. Keputusan menunjukkan hubungan langsung suhu dalam kecenderungan getaran. Juga ia menunjukkan bahawa diameter tiub mempunyai hubungan yang songsang kepada kecenderungan getaran struktur.

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LIST OF ABBREVIATIONS

DNS	- Direct Numerical Simulations
LES	- Large Eddy Simulations
FSI	- Fluid–Structure Interaction
CFD	- Computational Fluid Dynamic
FIV	- Flow-Induced Vibration
VIV	- Vortex Induce Vibration
RANS	- Reynolds-averaged Navier-Stokes
GS	- Grid Scale
SGS	- Subgrid Scale
CL	- Coefficient of Lift
CD	- Coefficient of Drag

INTRODUCTION

Piping systems conveying liquids are subjected to severe transient loadings whenever changes in the momentum of the fluid or piping structure are abruptly induced due to planned or accidental actions. Typical sources of transients are (Rocher, R. 2012):

1. valve slam
2. startup and shutdown of pumps
3. loss of coolant in nuclear reactors
4. vibrations induced by operating equipment installed on the line
5. Earthquakes.

Fluid around a structure can significantly change the structure's vibration characteristics. The presence of a inactive fluid decreases the natural frequencies and increases the damping of the structure. A dense fluid couples the vibration of elastic structures which are adjacent to each other. Fluid flow can induce vibration. A turbulent fluid flow exerts random pressures on a structure, and these random pressures induce a random response. The structure can resonate with periodic components of the wake. (Blevins, R. 2000)

If a structure is sufficiently flexible, the structural deformation under the fluid loading will in turn change the fluid force. The response can be unstable with very large structural vibrations once the fluid velocity exceeds a critical threshold value.

Vibration induced by fluid flow can be classified by the nature of the fluid structure interaction as effects which are largely independent of viscosity include added mass and inertial coupling. Unsteady pressure on the surface of a structure, due to either variations in the free stream flow or turbulent fluctuations, induces a forced vibration response. Strong fluid-structure interaction phenomena result when the fluid force on a structure induces a significant response which in turn changes the fluid force.

1.1 Problem statement

The volume flow rate of $0.024 m^3/s$ (Lee,H. et al,2009) is used to examine effect of the heated water flow on the circular tube. Cross bonding to different temperatures with values 298 K (Lee,H. et al,2009) 363K (Lee,H. et al,2009) 600K (Pironkov, P. 2010)

1.2 Objectives

To determine the effect of the temperature in internal flow related to FSI.

1.3 Scope of the study

1. Numerical solution will be used.
2. Include the pipe flow with and without temperature effect.
3. Investigate the effect of change of diameters of the pipe in constant flow rate.

1.4 Significant of the study

The heated tube has been widely used in the industrial application such as HVAC systems, heat exchangers, boilers, turbines, refineries reactors and most of the petro-chemical industry process.

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